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A model of cost-effectiveness is outlined which enables consideration of some non-financial, as well as financial, elements of educational systems at school or district levels. The model enables the decision-maker to compare educational outcomes of different units, to assess the impact of alternative levels of financial input, and to select alternative approaches to reach specified educational outcomes. Components of this model are student inputs, educational outputs, financial inputs, external systems, and manipulatable characteristics. Indicated are the potential applications of the model in different evaluation situations and its use to evaluate the cost-effectiveness of various financial inputs and of individual school programs. Related documents are EA 002 407 and EA 002 475. (Author/MLF)

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Cost-Benefit Versus Cost-Effectiveness Evaluation

What is cost-benefit and analysis? What are some of the difficulties encountered in applying the technique to the kind of decision situation which concerns most educators at the individual school or district level? Finally, what kind of evaluation technique might be used instead of cost-benefit analysis for evaluating educational systems?

Techniques such as cost-benefit analysis are designed primarily as aids in making prescriptive decision statements. Consequently, those interested in using such procedures are concerned with providing data about real world situations that will allow decision-makers to act. In this kind of analysis, therefore, we attempt to find the value of alternative courses of action not only in terms of the outcome dimensions or outputs of the treatment but also in terms of the financial costs that are associated with each alternative. Most educators, it seems, have much less difficulty accepting benefits or outcome measures as an indication of value than they do in accepting costs. Despite the educators' disdain for them, costs are also of considerable importance. The only

time an individual can safely disregard cost is when he finds himself in the happy situation of having unlimited resources--not only in terms of material goods and services but also in terms of time and energy. To be in a situation in which costs can be disregarded is certainly not the reality of today.

The idea of cost-benefit analysis is deceptively simple. It requires only that we identify the costs and benefits associated with our alternatives. Once we ascertain the costs and benefits of alternatives, we can easily select the alternative that yields the largest benefits for a given cost, or we can select the alternative which will yield the least cost for a given level of benefits. The often-stated idea that cost-benefit analysis attempts to maximize gains or benefits while minimizing costs is not true; however, if it were true, the task would be impossible. It is analogous to asking a geographer to find the deepest lake at the highest elevation. No matter which lake he selected, there would always be a slightly shallower lake at a slightly higher elevation; eventually, he might find himself beside a drop of water on the summit of Mount Everest. However, if we restate this task by limiting either the depth of the lake or the elevation, then the problem can be solved. The same logic applies to cost-benefit analysis. It is impossible to choose a policy which simultaneously maximizes benefits and minimizes costs. There is no such policy. If we compare policies A and B, we might find that occasionally A yields greater

benefit yet costs less than B. In this case we might say that A dominates B. A, however, does not minimize cost while maximizing benefits. Maximum benefits are infinitely large, and minimum cost is zero. If we seek a policy which has this outcome, we obviously shall not find it.

In order to use cost-benefit analysis in a fruitful way, we must be able to specify all costs and benefits--our decision criteria. In addition, we must specify those which are variable and those costs or benefits which are limited or constrained. At the very least, limits must be set on the variability which will be allowed to each (costs and benefits) and on the acceptable trade-offs between gains on one dimension and losses on another.

Cost-benefit is primarily an economic analysis. In other words, the method of cost-benefit analysis is a tool of the economist developed primarily to examine economic entities. One of the main requirements of cost-benefit analysis is that both input and output measures be specified in the same units, namely dollars. This concept is important if one is to make judgments about specific programs. Thus, in the private sector of the economy, a specific business firm might decide to increase its capitalization in order to expand one of its programs which has a favorable cost-benefit ratio; that is, it is likely to yield a monetary profit.

Applications of cost-benefit analysis in the public sector of the economy primarily have been made in the areas of water

resource development and national defense. In each instance the technique demands a specification of the multiple outcome dimensions in terms of dollar benefits. As a result, while the major direct benefit of the construction of a hydroelectric project might be the dollar value of the electrical energy which has been produced, there are indirect benefits--such as relief from losses of home, property, farm crops, etc.--from potential flooding. Somewhat more intangible benefits, such as the physical and mental well-being of individuals relieved of the fear of floods, are also assigned dollar values (McKean, 1958).

Traditional applications of cost-benefit analyses in education have been primarily at very large levels of educational aggregation, e.g., states, regions, nations. This situation is easily understandable, for it is primarily at such levels that data are more readily available on dollar values of educational outcomes. Thus, Becker (1962) focused his attention on the social gain from college education as measured by its effects on national productivity and concluded, among other things, that "private rates of return on college education exceed those on business capital" (Becker, 1962). In another study (Hansen, 1963), the internal money rates of return were calculated for successive stages of education where returns were estimated from cross-section data of the incomes of individuals classified by age and education. Finally, in 1966, Hirsch and Marcus examined the costs and benefits of universal junior college

education as compared to alternative uses of the same financial resources for summer programs in secondary schools.

What is evident in the limited number of examples above is that, in each case, the outcome dimensions have been transformed into dollar benefits utilizing traditional economic indices. But, because school district boundaries are very often not coterminous with other governmental entities, economic indices are not available at the level of individual schools or school districts. Yet, even if economic indices were available, cost-benefit analysis might still prove appropriate by virtue of the mobility of student populations in school districts, complicated by other difficulties related to identifying long-range economic benefits for educational units as small as individual schools. Moreover, cost-benefit analysis may not address itself to the most relevant question for the kind of unit about which we are concerned. In short, we are concerned not so much with the economic consequences of certain investment decisions in education as with evaluating the system components in terms of the objective dimensions defined.

Unlike cost-benefit analysis, which poses no direct challenge to the general decision-making machinery of the political system, we wish to examine a real-world decision situation in which not all outcomes are definable in economic terms.

In summary, when cost-effectiveness is referred to in the context of this paper, it should bring to mind a model that will enable us to consider relevant elements of educational systems at

school or district levels of aggregation in order to (a) compare educational outcomes of different units, (b) assess impact of alternative levels of financial input, and (c) select alternative approaches to the achievement of specified educational outcomes.

COMPONENTS OF A COST-EFFECTIVENESS MODEL

What are the components of a model that allows the decision-maker to evaluate education through a cost-effectiveness evaluation? First, it is necessary to define what we mean by a model.

To put it briefly, a model is simply an attempt at classifying the major elements of an entity or a phenomenon with regard to their functions and interrelationships in order to observe more easily how the elements function within the entity, how they enable the entity to operate, and how they act upon one another. In this way, we can also determine the consequences of modifying the elements. Most models reflect the bias and interests of their developers. This one is no exception; our prime interest is a consideration of administrative and financial variables in education, specifically where a single school or a school district is the unit of analysis. To be sure, an evaluation model, or for that matter any model, is a simplistic statement or representation of sets of complex interrelationships; but such a representation is intended only to help the model builder to structure the universe which concerns him.

What elements comprise our model of evaluation? "Student inputs" are an aspect of our evaluation model. The term refers to the nature and characteristics of the students entering the

program to be evaluated. "Educational outputs" are another aspect of the model. By "educational outputs" we mean two things: (a) cognitive and non-cognitive changes which take place in students after they are exposed to the instructional program and (b) the impact of the program upon systems external to it (home, community, other programs, etc.). A third component of the evaluation model is "financial inputs," which refer to the financial resources made available for carrying on the program. "Manipulatable characteristics," a fourth element of the model, are the descriptive characteristics (e.g., personnel, school organization and programs, and instructional program) of the way in which financial inputs are utilized within the program in combination with the student inputs. Finally, our evaluation model must consider "external systems," an aspect which is the framework of social, political, legal, economic, and other systems outside the school, formal or informal, which encompass the program, have impact upon it, and are, in turn, modified by the outputs of the program.

In the discussion of manipulatable characteristics, we act under the assumption that they are the only administratively manipulatable set of variables. For the sake of this model, we will assume that (a) external systems are not immediately altered by the outputs of the system and (b) that the school decision-makers have no control over which external systems are allowed to impinge

upon the school. If we were to maintain that feedback immediately changes the system, this would imply a dynamic model rather than the static model considered here. The second assumption implies that no attempt will be made to change the nature of the student inputs to the system; that is, we do not usually concern ourselves with the consideration of possible changes in the community that would alter the nature of the student inputs. We act, too, under the assumption that student inputs are relatively non-manipulatable from outside the system. Thus, we concern ourselves with the manipulatable variables within the system that can be manipulated and altered to maximize student outputs. We recognize that there is a weakness in this assumption and that there are some school-related manipulations that could be instituted which would change the nature of the student input. Instances of this are bussing, changing of school boundaries in order to "juggle" student inputs to specific schools, community educational resources (such as education resource units in disadvantaged areas), and pre-school programs (such as Project Headstart). The assumptions of a static model and of nonmanipulatable external systems seem necessary at this early stage of the model development.

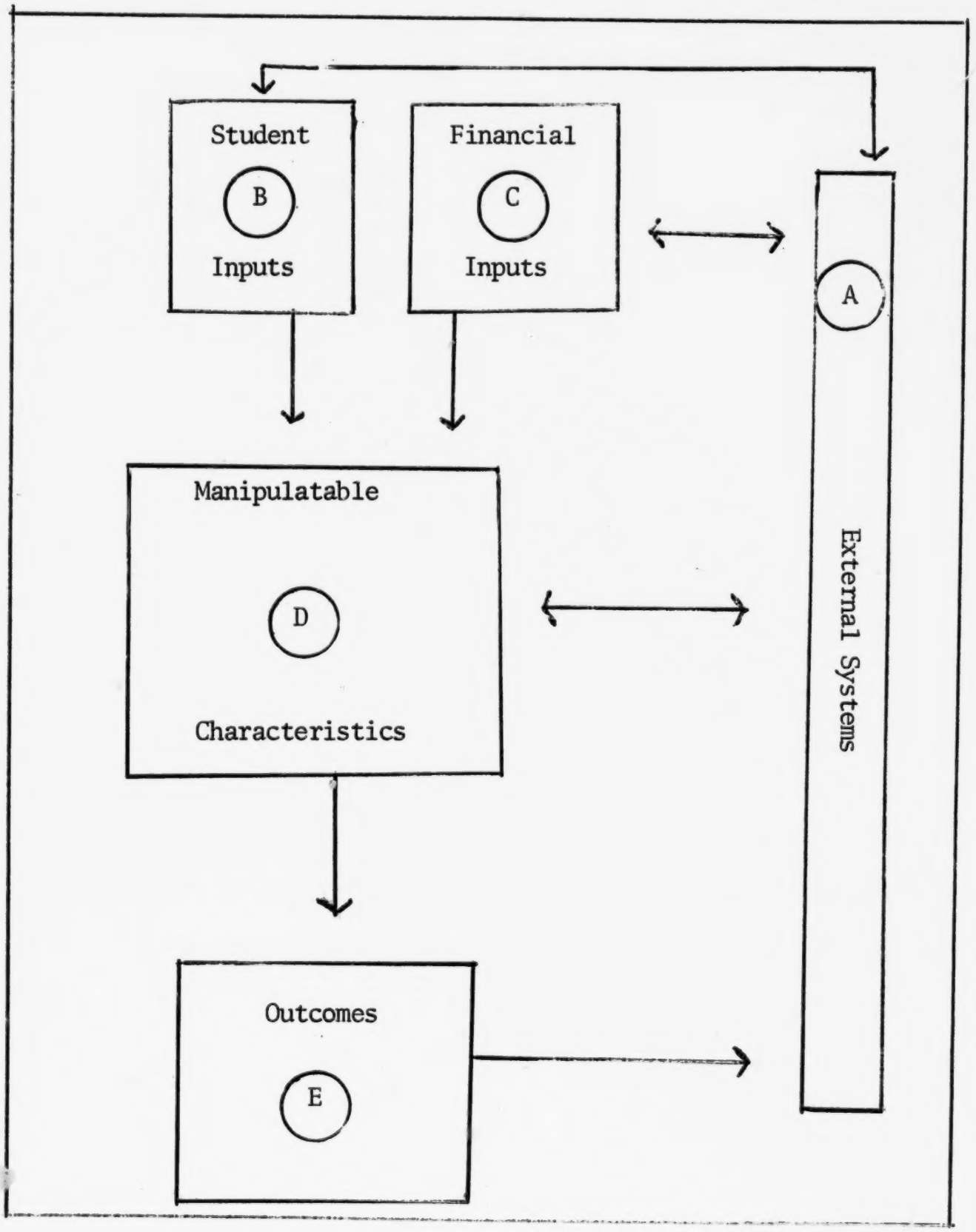
With our definition of evaluation and some of the limits we are imposing in mind, it is now possible to discuss the evaluation model.

Student Inputs

We will consider the student input as a description or measure of the student being introduced into the system or, in the case of a larger unit of instructional program, as an aggregated, statistical description of the students being introduced into the system. (See Figure 1) In the ideal world, when students enter the system, they are given a complete battery of all the traditional kinds of achievement, intelligence, and personality tests, as well as questionnaires and other documentary data describing their homes, status in the community, family background, family memberships in other social systems, and the like. Unfortunately, the ideal world does not exist. We must, therefore, develop a series of proxy measures of student inputs. Very frequently, intelligence scores are available for entering students; also, there is usually a small amount of family data available in the cumulative record folder. Occasionally, achievement tests given in the preceding year or two have been transferred and are available as a measure of the achievement starting-point of the students in the system. A considerable amount of additionally desired data must, consequently, either be collected in the school or, more often, inferred from other more accessible measures. As a result, we often look at the community and the characteristics of the community as an indication of the kind of student input that is being introduced into the system.

Figure 1

Cost-Effectiveness Model



Financial Inputs

There is a second class of inputs to the system--financial inputs. If we think of a district as a system, then not only do students enter the system, but finances are provided from local, state, and federal sources and are, in part, a means of implementing different sets of mediating factors within the system. Perhaps it is relevant to determine the portion of the total resources derived from each of the governmental levels. Perhaps it is also important to designate the specific authorizations from federal funds or special state programs to be aware of the "strings attached" and consequent implications for resource utilization within the system.

If we were concerned with evaluating a part of the system, such as the mathematics program or the guidance program, it would be necessary to determine the nature and amount of the financial input to that portion of the system. Unfortunately, present accounting practices in all states provide data only on functions of expenditures rather than on programs of expenditures; i.e., data are available on a number of factors such as the amount spent for administration, maintenance, operation, instruction, and fixed charges; but these data are not available on a program basis. Thus, the desire to include financial input data in evaluation studies would require special budget review or new accounting procedures, depending upon the level of aggregation under consideration.

External Systems

The school is placed within the framework of numerous social systems (external social contexts). For example, in the case of the individual school some of the contexts are the community, the district, the nature of the district organization, other governmental systems such as the city and the county, and the patterns of community organizations and of community participation. Each of these external systems, by the nature of the differentiated functions it serves, places sets of demands and restrictions both upon the educational system (school) and upon the individuals within the system. Each of these systems serves specific integrative, adaptive, goal-attaining, and pattern-maintaining functions in the macro-system. Consequently, it is necessary to identify and quantify these external systems' characteristics and relationships which are relevant in terms of the contribution they make towards producing the educational outputs of the system.

In actuality, the external systems interact with the educational system. While each of them may be conceived of as having its own inputs, particular sets of mediating variables, and outputs, each is, in turn, an external system to the educational system and vice versa. Thus, each system external to education may be considered as both a source of inputs and a receiver of outputs.

Manipulatable Charcteristics

A fourth group of elements of the evaluation model is termed manipulatable characteristics. The financial input to a system can be utilized in a great number of ways. We can decrease the student-to-teacher ratio, establish standards which insure the hiring of teachers with specified characteristics, develop different administrative arrangements within the school, provide more library books, provide more textbooks, introduce different curricula, use different instructional procedures, or provide additional supplies. Thus, these manipulatable characteristics are subject to change or manipulation by educational decision-makers at all levels. We have no definitive evidence, however, indicating which combination of these characteristics is most effective in achieving the objectives of the school, i.e., in producing desired educational outputs.

At this point, it is only fair to indicate that we do not mean to imply that all these characteristics which have impact on educational outputs are related to financial input. For example, the cost of implementing certain alterations in the school environment or in the attitudes of teachers may be relatively cost free. Frequently, the instructional procedure used by the teacher in the classroom (the substitution of one procedure for another) has little or no additional cost attached to it. However, some changes

in the system such as some of the administrative or organizational arrangements and many instructional procedures which are technologically based are extremely costly. Consequently, the potential output achieved by the change must be examined in terms of the costs involved.

To maintain that more money should be provided for teacher salaries and that in this way, in all likelihood, the educational program will be improved is an easily defensible position. There is evidence that a relationship exists between higher teacher salaries and educational quality. The real question, however, is to what extent a given dollar input, if utilized in an alternate manner, would increase certain educational outputs. This is a cost-effectiveness question and is, after all, one of the elements at the heart of evaluation or, at the very least, one of the reasons why we evaluate.

We have noted that the selection of different sets of mediating factors may lead to the maximization of educational outputs in a system. There is, though, another point to be made: not only are there different sets of manipulatable characteristics applicable for producing given educational outputs; but, significantly, these sets of variables may produce quite different levels of change in the educational outputs in different systems or for different student input groups. James Coleman observed this point in a study

for the Civil Rights Commission entitled Equality of Educational Opportunity. He noted that the "inference might then be made that improving the school of a minority pupil may increase his achievement more than would improving the school of a white child increase his." Similarly, the average minority pupil's achievement may suffer more in a school of low quality than might the average white pupil's. He concluded that "this indicates that it is for the most disadvantaged children that improvements in school quality will make the most difference in achievement" (Coleman, 1966). Appropriate manipulatable characteristics, therefore, are functions not only of the desired educational outputs but of the nature of the student inputs and of the given system as well.

As mentioned earlier, we believe these characteristics to be the only set of variables that can be manipulated. This belief is a simplifying assumption, in part, because it allows us to deal with a static, instead of a more complex dynamic model. Also, the bias implied by this assumption follows from the basic intent of the model we are seeking to construct, that is, a decision-making model or, more specifically, a model designed to aid in evaluating schools and the operations of schools.

Outcomes

The first set of outcomes of concern to us in the model is student outcomes which are affected by changes that take place in

students from the time they enter the system to the time they leave it. Many of these changes are produced by the nature of the costly manipulatable factors within the system. Here, again, there is a problem, for the outcomes of a school or of a district cannot be measured solely by the scores of students on academic achievement tests.[1] What are the noncognitive aspects of outcome or output? How has the behavior of students changed? What is the relationship between the activities that take place in a district or a school and the eventual success of students in their vocational or future educational endeavors? How does the student's educational experience aid him in dealing with political problems and activities and with cultural affairs? To what extent does the school's social situation, as well as what is learned in classes, affect the student? These are only some of the unanswered questions related to the identification of educational outcomes; and, of course, they can be solved only through further research and investigation.

While there are two prime inputs into the system (student and non-student or financial), we will consider that there are no financial outcomes except as we are willing to place financial value on

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[1]We would readily admit, however, to the chagrin of many reluctant school administrators, that this measure at least would be a feasible starting point.

certain behavioral changes or except as student outcomes yield financial or economic returns, either individual or social.[1]

The second set of outcomes in the model is the non-student outputs. The two groups of outcome measures (student and non-student) may be thought of as feedback loops in which each modifies, to some extent, the nature of future inputs to the system. The changes in students, for example, have social, political, and economic implications; that is, the very nature of the external systems is altered by changes in student outputs. There are, however, other outcomes of the school: the impact of educational decisions made as a part of the "manipulatable characteristics" has repercussions in the external systems. Frequently, these outputs are only tangentially related to individual students or to student outputs. For example, the nature of many of the decisions about the proper utilization of resources may produce innumerable educational outcomes not directly student-related. In brief, decisions which influence the number and salaries of teachers, as well as the number and salaries of classified personnel, could, in many ways, modify the nature of some

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[1]There is evidence that this is a reasonable approach. See Becker; also Miller, "Income and Higher Education: Does Education Pay Off?" (Ed.) S. J. Mushkin, Economics of Higher Education (Washington, D. C.: U. S. Department of Health, Education, and Welfare, Office of Education, 1962); and Schultz, "Investment in Human Capital," American Economic Review, LI (March, 1961), 1-16.

external systems, especially if these employees were to reside in the district. To what extent do teachers paid at different salary levels have the economic ability to forego other earnings and instead participate in community activities and organizations? Furthermore, how is the nature of these external systems modified by the educational decision that determined the particular combination of manipulatable characteristics which allowed greater salaries for the teachers? Also, how do the type and quality of teachers selected affect the changing nature of the community? Another example might be the impact upon the economy of the community brought about by the selection of manipulatable characteristics which include large capital investment or a large amount of supplies and materials locally purchased. How do the educational decisions related to whether school transportation will be provided or the hours of school or the scheduling of student time, in terms not only of regular session classes but with respect to recreational and summer use of school facilities, have implications for parental employment patterns or avocational participation? And, to what extent does the school, as a merchant of facts, knowledge, and ideas, influence community attitudes on political, social, and cultural issues? Finally, although the list could be extended greatly, how does the impact of the selection of manipulatable characteristics upon the social patterns within the school relate to breaking down or reinforcing patterns within the systems external to the school?

We realize that it is not possible to isolate every conceivable element of the total system and to determine its value or its individual, contributory relationship to the educational outputs of the system. Nevertheless, it is requisite in any evaluation scheme to identify and control as many as possible of the factors thought to be significant; for the more we can isolate these factors, the more accurate our analysis can be.

Our next step must be an analysis of how our model might be used in different kinds of evaluation situations.

POTENTIAL APPLICATIONS OF THE COST-EFFECTIVENESS MODEL

As we have already noted, traditional cost-benefit approaches do not provide the necessary data or meet the educational needs to which we have addressed ourselves. In this section, therefore, the cost-effectiveness analysis model we propose is clarified, and its uses in different evaluation situations are described. For purposes of this paper, "program" pertains to a package which encompasses all the agency's efforts to achieve a particular objective or set of allied objectives. In educational terms, programs are defined as secondary education, junior college education, etc. However, it is difficult to assemble and describe a package which would encompass all the efforts to achieve a sub-objective like teaching elementary

school children to read; that is, it would be extremely difficult to consider the cost elements and program elements of all aspects of the total school program related to the reading achievement of children.

Thus, "program alternatives" are differing possible approaches towards achieving the same or similar objectives. In education, public schools and private schools might be program alternatives; if different schools are assumed to be working towards the same objectives, in whole or in part, then the total programs of these schools also may be considered as program alternatives. Different schools have different program alternatives. Consequently, one might evaluate the success of different program alternatives in achieving the specified objectives of the programs. Since there is varying quality in student inputs to programs, one would, of course, expect that the outputs would vary; and in order to evaluate the program alternatives, one must somehow be able to control for differences in student input and external systems.

This notion of alternative programs can be extended. If programs are similar in their uncontrollable characteristics (student inputs and external systems) but different in the levels of financial input, they may be thought of as alternative programs for achieving the same or similar objectives. By taking the "black box" approach to the problem, one could evaluate the cost-effectiveness of alternative programs where alternative programs are defined as differences

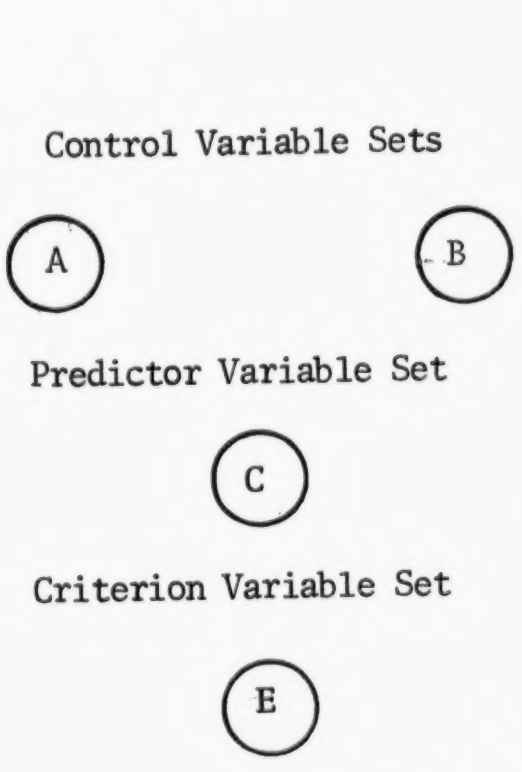
in financial inputs to the system, without regard for the manner in which these inputs are utilized.

Consider this evaluation in terms of the model described in Figure 1, where variable set A refers to the external system, variable set B refers to the student inputs, variable set C refers to the financial inputs, variable set D refers to the costly manipulatable characteristics, and variable set E refers to the outcomes. Using this simple diagram and the variable sets as numbered, note that alternative instructional programs (school financial resources) can be evaluated in terms of cost-effectiveness, using variable sets A and B as controls with variable set C financial inputs as the predictor variable set, and variable set E as the criterion (See Figure 2). A question emerges from the model: When student inputs and external systems are held constant statistically, what is the outcome change (on each of a number of dimensions) associated with a dollar increase in financial input?

A second kind of cost-effectiveness evaluation might be concerned with the assessment of specific instructional programs. In this case, we would study specific total institutional programs of schools on the basis of their performance on the outcome dimensions after we have accounted for the effects of specific uncontrollable characteristics of their own system. Thus, if one merely wanted to evaluate schools as institutions, in terms of what kind of job they

Figure 2

Evaluating Cost-Effectiveness of Alternative Instructional Programs--School Financial Resources



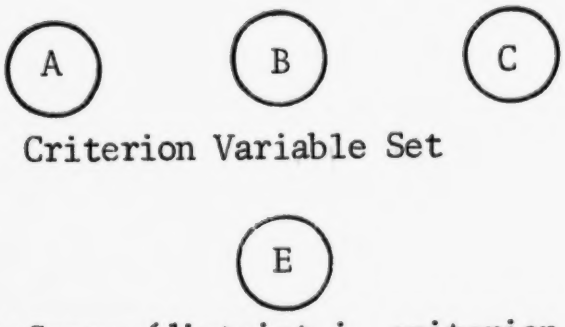
are doing relative to the resources (human and fiscal) available to them, the model discussed above could be invoked to perform a cost-effectiveness analysis. In short, if financial inputs are considered one of the uncontrollable variables in the system and are, therefore, contained in the model, the degree to which an individual institution achieved success on the outcome dimensions at the level we would predict is a measure of the cost-effectiveness of the institution's total program. For example, institution 1 with student inputs (S_1), external systems characteristics (E_1), and financial inputs (F_1), might be predicted as achieving various criterion dimensions at stipulated levels, $C_{1,1}, C_{2,1}, C_{3,1} \ldots C_{i,1}$. When the institution matches or exceeds these predictions in terms of outcomes or consequences assumed to be favorable, or at least not deleterious, the institution is being run efficiently, relative to each of the specified outcome dimensions.

Thus, the second type of cost-effectiveness study that might be done is of a particular school. The evaluation of an individual school program would be in terms of the statistically derived expectations for that program in light of its own uncontrollable characteristics (See Figure 3.). The cost-effectiveness scores for a school would be determined on the basis of ratios of actual to predicted achievement on each of the criterion dimensions. Therefore, a school whose actual achievement on a criterion measure exceeds its predicted

Figure 3

Evaluating the Cost-Effectiveness

of Individual School Programs



Cost-Effectiveness Score (district i, criterion measure 1)

$$= F \left(\text{Actual } E_{1,i}, \text{ Expected } E_{1,i}\right)$$

i.e. $\dfrac{\text{Actual } E_{1,i}}{\text{Expected } E_{1,i}}$ or Actual $E_{1,i}$ - Expected $E_{1,i}$

achievement could be said to be cost-effective with respect to the specified criterion dimension.

We may consider the concept of "alternative ways to do a given job" borrowed from PPBS (Planning Programming Budgeting Systems) as a useful means of providing the framework for a third type of cost-effectiveness evaluation. The "given job' notion means that the output to be produced and the program have been predetermined. The question at any phase of the program becomes: Can we alter the production or distribution technique and by doing so (a) improve the timing of the production or delivery (fulfill program objectives in a shorter period of time, thereby consuming less student time), or (b) improve the quantity and quality of the items being produced (educate a greater number of students in the program or achieve a higher level of objectives or fewer undesirable consequences), or (c) modify the unit cost or total cost of the production or delivery (which, in education, would refer to fewer financial input dollars to achieve the same objectives)? "Alternative ways to do a given job" takes the program as given or specified and increases the possibilities for changing the mix of input utilization alternatives, thereby modifying the program. This function seems quite appropriate in terms of the problem at hand, for while the question about alternative educational programs provides some answers in terms of the cost-effectiveness of total educational systems, it fails to render

insights into the attributes of the system which make a difference in the production of educational outputs.

There are, of course, vast differences from place to place in the quality of resources available for use as alternatives or options. Where the economist thinks of teachers, materials, etc., as inputs to the system, he refers to quality differences in inputs. In this model, which is geared to the decision-making of the educational administrator, cost factors such as teachers, textbooks, clerks, and aides are viewed as costly manipulatable characteristics of the system. Each of them represents a potential means of financial input utilization.

A major responsibility of the state is to make available to local districts input utilization options of high enough quality to insure that the school districts may operate efficiently. States assume this responsibility in a number of ways. In part, the input utilization options are defined by the economy of a state, by alternative employment opportunities, by access to higher education, etc. Also, the state government defines the quality of the input utilization options by the state-established legal requirements for education and by state procedures for credentialing teachers. Thus, what a financial input will buy in a school district (the purchasing power of a financial input) is determined, in part, by the state government, the geographic region, and even, perhaps, by the nature of the individual community.

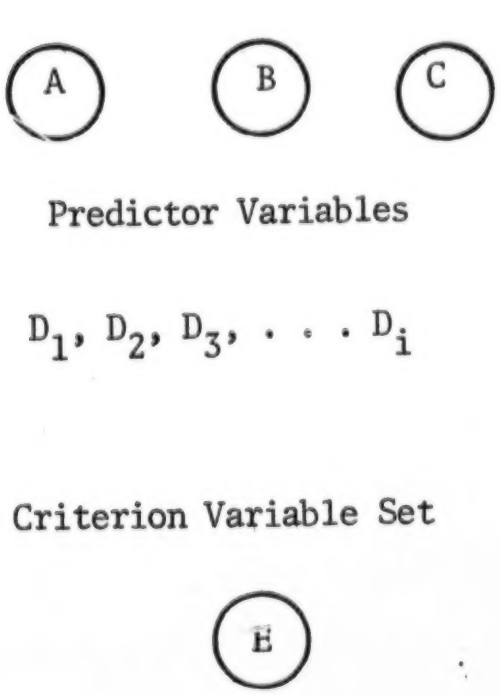
We have noted that it is not possible or appropriate to maximize effectiveness while minimizing costs. In terms of the problem posed here, then, it is impossible to consider simultaneously fulfilling program objectives in a shorter period of time, modifying the unit cost of the production of educational outcomes, and providing a higher level of achievement of educational objectives. Several of these must be specified as program constraints with one specifically designated as the purpose of the cost-effectiveness analysis. A consideration of the evaluation of the cost-effectiveness of specific costly manipulatable characteristics of the system (teachers, textbooks, clerks, equipment) has been proposed. This proposal implies a concern for the maximization of outputs which utilizes the options for resource allocation within the system, the total financial input and student inputs, including time, constrained within the model. In terms of our model, this process requires the consideration of variable sets A, B, and C as control variables, individual variables D as predictors, and variable set E as criterion measures. (See Figure 4)

Another question inevitably arises: When student and financial input characteristics of the external system are held constant statistically, what is the effect of each costly manipulatable characteristic of the system upon increased educational outputs? Such an evaluation requires, in addition to drawing the relationship between the

Figure 4

Evaluating Cost-Effectiveness

of Input Utilization Options



costly manipulatable characteristics and the various outcome dimensions, that one examine the cost functions of the costly manipulatable characteristics.

The procedure, then, is to determine the change in output associated with each incremental unit change in each of the costly manipulatable characteristics. There are at least three major problems that one might anticipate at this stage of an analysis: (a) there would be difficulty in obtaining accurate cost data related to the manipulatable characteristics; (b) there would be difficulties in dealing with cost-effectiveness estimates in the light of systems interrelationships, and (c) there would be difficulties in generalizing to individual cases (if such generalization were desired).

With respect to the first of these problems, actual data would, of course, be preferable. However, accounting systems do not usually provide this information. In instances where actual data is not possible or feasible, costs might be derived by constructing a cost production function; e.g., in the analysis of a number of cases, data might be derived relating the presence and extent of various manipulatable characteristics to some cost function, such as current expense of education. In this way, a cost curve could be derived describing the production costs related to those characteristics. Such a production function might be derived using historical or longitudinal data, as was done in a study reported by Adelson,

Alkin, Carey, and Helmer (1967); or a production function might be produced using cross-sectional data (Katzman, 1967).

There is no simple solution for the second of these problems, systems interrelationships. One might seek to isolate the individual variable from its covariants through appropriate statistical controls. From these statistics on the interrelationships between covariants, one could then determine the expected changes in them that would be associated with an incremental unit change in a given mediating variable. Perhaps systematic use of judgment might be utilized to obtain and isolate the nature of the interrelationships. Then, starting with the statistical data, appropriate cost characteristics could be assigned to elements of the system. Moreover, procedures such as path analysis possibly could be utilized to provide greater insight into the data.

Another possible solution is the use of expert judgment, systematically obtained, e.g., the Delphi Method (Gordon and Helmer, 1964; also Adelson, Alkin, Carey, and Helmer, 1967). It could be quite fruitful to assemble a group of knowledgeable, educational decision-makers representing a variety of backgrounds and interests. They could be allowed to consider the nature of the system interrelationships between variables and from these relationships form some judgment of the cost-effectiveness of each of the available manipulatable characteristics of the system. This Delphi process

of summarizing findings--allowing for discussion and presentation of deviant views, feedback to participants, and several additional rounds of the same procedure--might lead to consensus or at least to an understanding of the nature of the dissenting opinions.

The third problem posed is related to the difficulties of generalizing to individual cases. One possible solution to this problem rests with the development of a typology of schools to be used as the moderator variable in the prediction of outcomes in the analysis. There are difficulties related to the use of statistics (such as regression coefficients derived from the analysis of a set of data) in predicting criterion measures (outcomes) for individual cases. The accuracy of a predicted outcome for an individual school, will depend considerably on the type of school as the school varies its costly manipulatable characteristics. To put it simply, one would not expect the same effect from changing the counselor-student ratio at Beverly Hills High School as he would at a small, rural high school. There is certainly a typology of schools that will act as a moderator variable in the prediction of outcomes. The notion of grouping variables being worked on by Klein, Rock, and Evans (1967) at Educational Testing Service might be quite appropriate for use in solving this problem.

Conclusion

In this paper, we drew the distinctions between cost-benefit analysis and cost-effectiveness evaluation. We showed that cost-benefit analysis relies almost exclusively on financial benefits and is, therefore, of limited value in assessing education, where many outcomes cannot be defined economically.

Moreover, we outlined the various components of a model that we believe will enable the decision-maker to perform cost-effectiveness evaluations in education. In the model, we spoke of the need to consider "student inputs"--the characteristics of students entering the system; "educational outputs"--cognitive and non-cognitive changes that occur in students after exposure to an instructional program; "financial inputs"--financial resources available to carry on the program; "external systems"--the social, political, legal, and economic structure of society; and, lastly, "manipulatable characteristics"--those aspects of the program which are resource-consuming and which are administratively manipulatable.

Finally, we indicated the potential applications of the cost-effectiveness model in different kinds of evaluation situations and how one model is to be used to evaluate the cost-effectiveness of various financial inputs and of individual school programs. In conclusion, we showed that the cost-effectiveness evaluation model could be used to assess the worth of "alternative ways to do a given job."

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